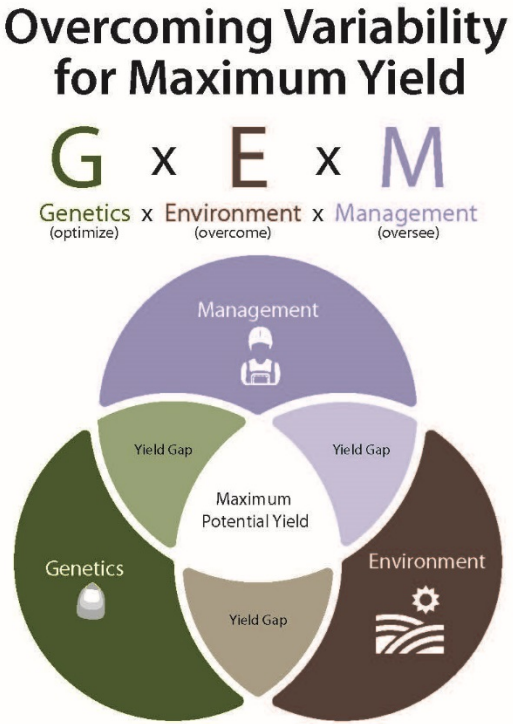
Application of Genetics x Environment x Management Concept to Grape Production

Framework for Innovation

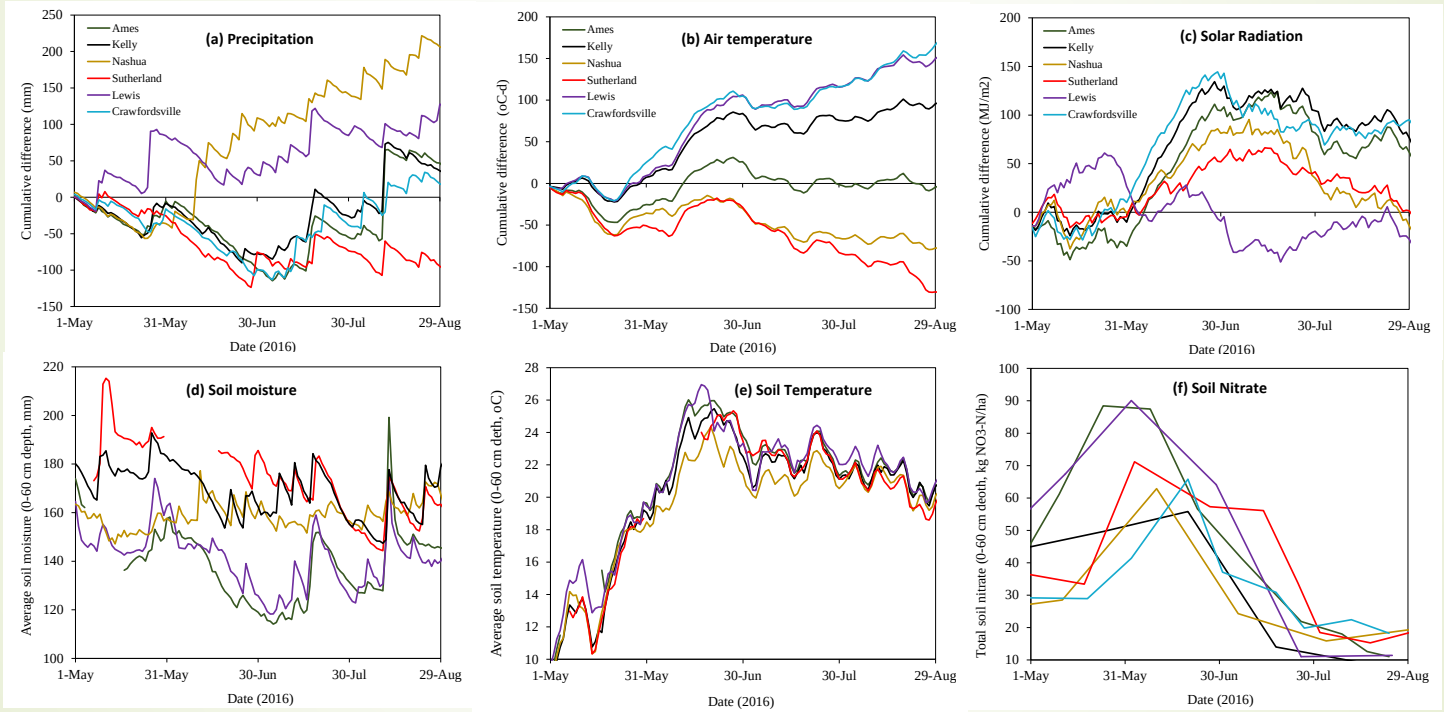


Context

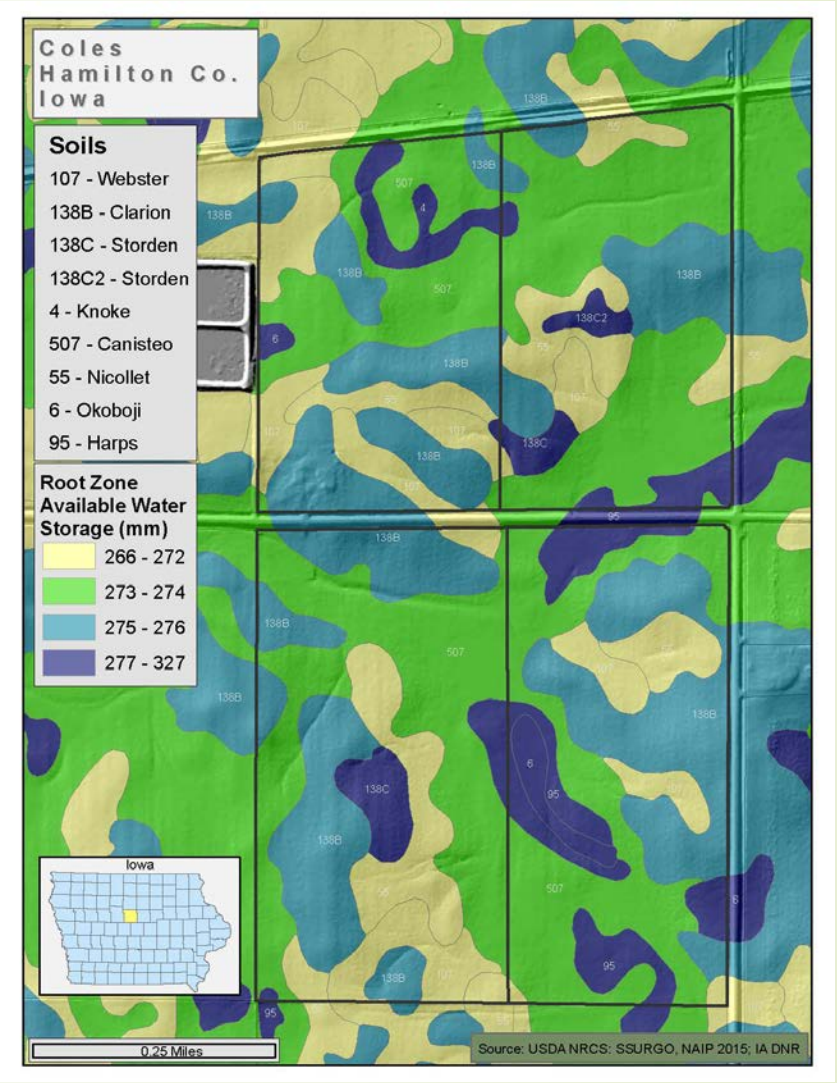
G x E x M

- Genetics – the available genetic resources including crop diversity
- Environment – soil and weather
- Management – all decisions that we make during the course of a production cycle (this includes the sociology of why we make those decisions)

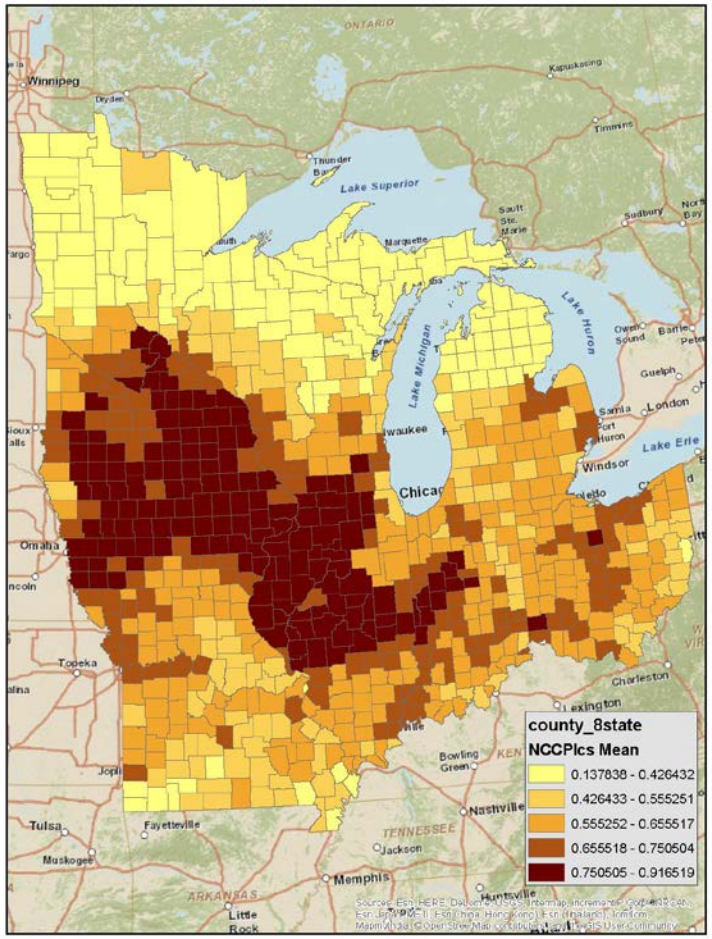
Environment 2016 Across Iowa



All soils are not equal in their water holding capacity



Variation in NCCPI across the Midwest



Management

- Goal is to overcome the variation in the environment
- Understand what questions to ask
- What effects do management practices have on crop response?

Expansion of G x E x M

- (G x E x M)P
- P represents the post-harvest system to enhance or preserve the value of the grain, fruit, or vegetables produced
- In grapes, the P becomes the difference between a good wine and great wine

G x E x M

- Genetics – the available genetic resources including crop diversity
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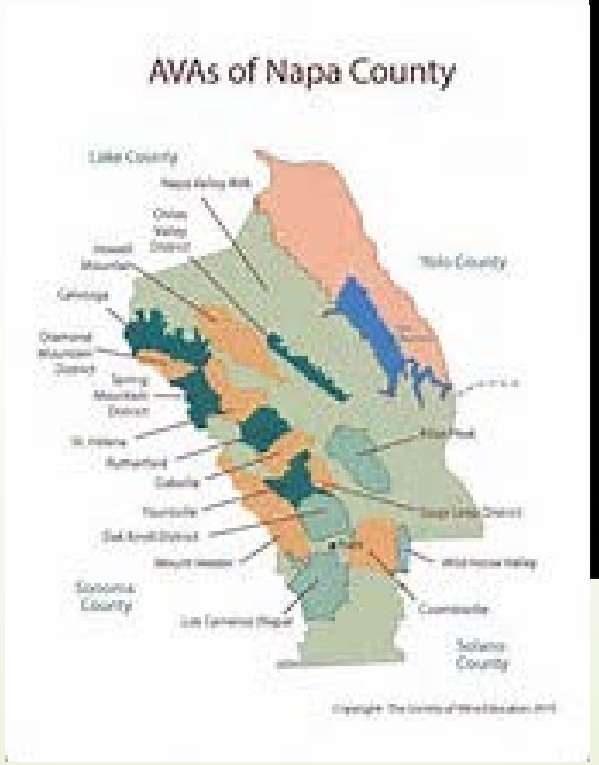
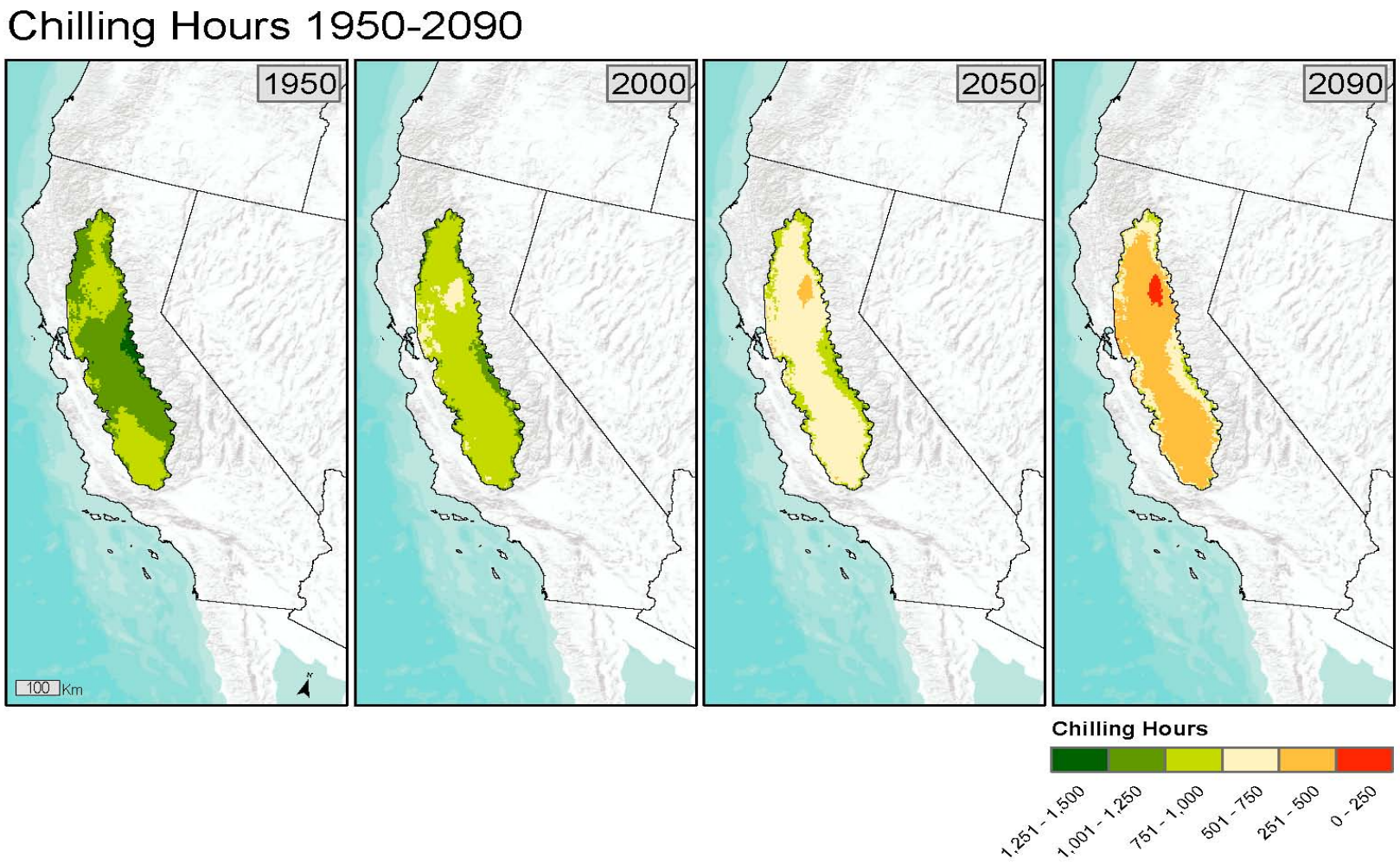
(G x E)

- Where do we grow plants – agroclimatic zones
- How well will crops produce in a given area across all management

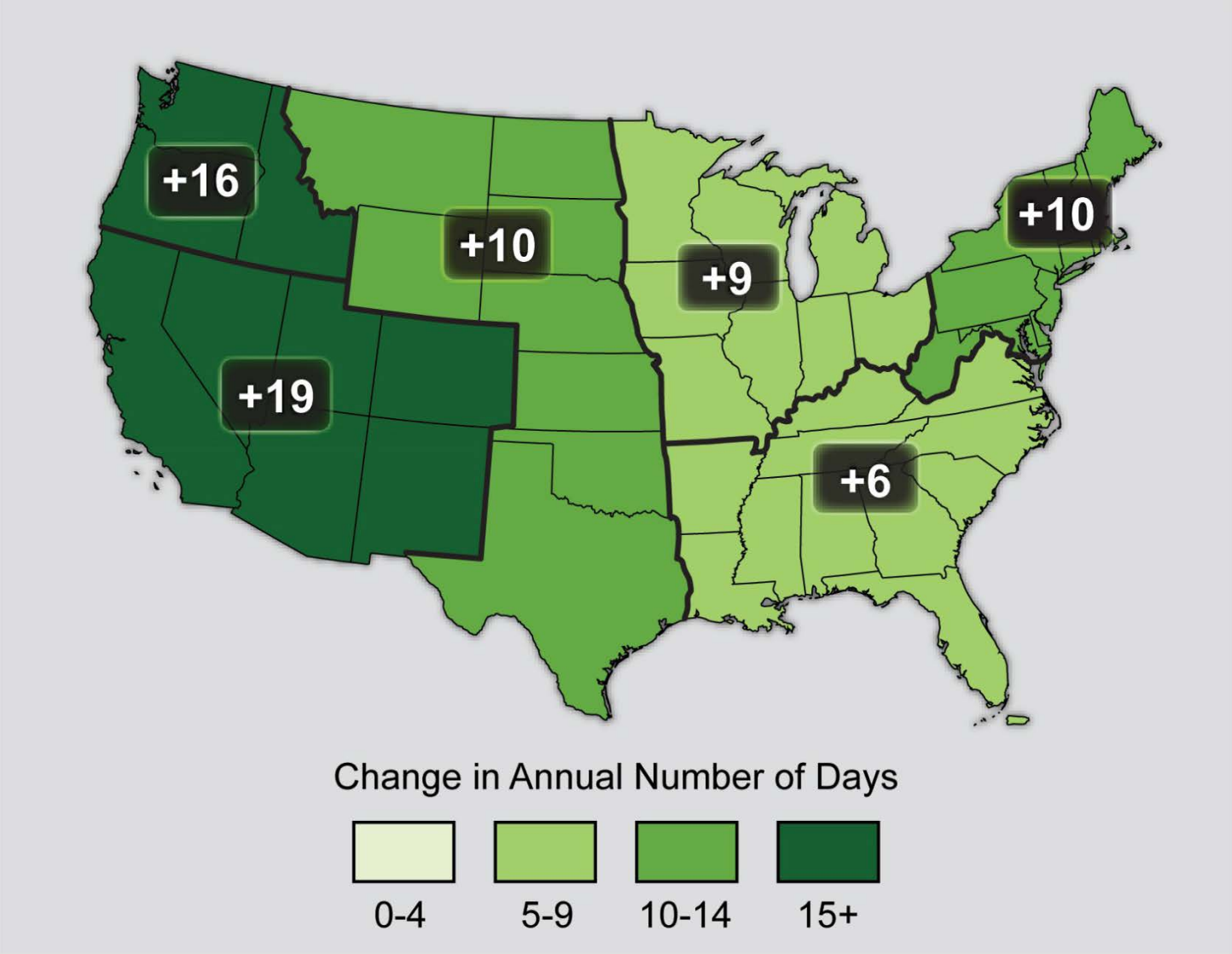


Agroclimatic Indices

- Simple growing degree days (thermal units)
- Simple chilling hours
- Complex indices relating temperature, solar radiation, soil water content



Observed Increases in Frost-Free Season



NLAE
National Laboratory for Agriculture and the Environment

G x E x M

- Genetics – the available genetic resources including crop diversity
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Applications of G x E x M to Grape Production

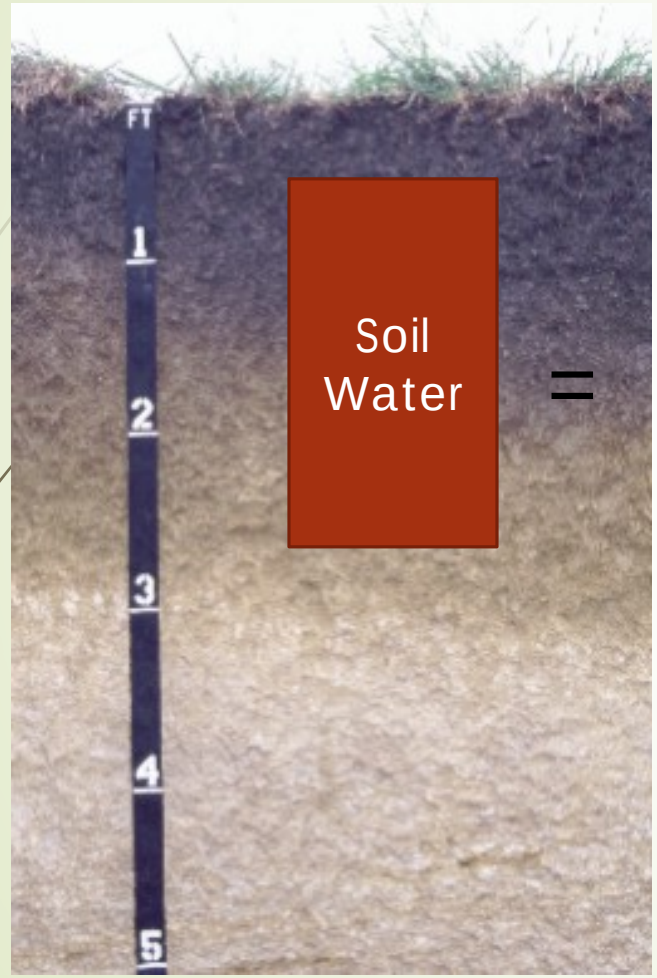
- Management aspects
  - Water
  - Nutrients
  - Pests
  - Cover crops

(E x M)

- How does environment interact with various management practices within a given genetic stock?

Alter the humidity in the canopy with a change in how we trellis the vine leading to a change in disease pressure.

SOIL WATER BALANCE



Inputs

Precipitation

irrigation

-

Losses

Evapotranspiration

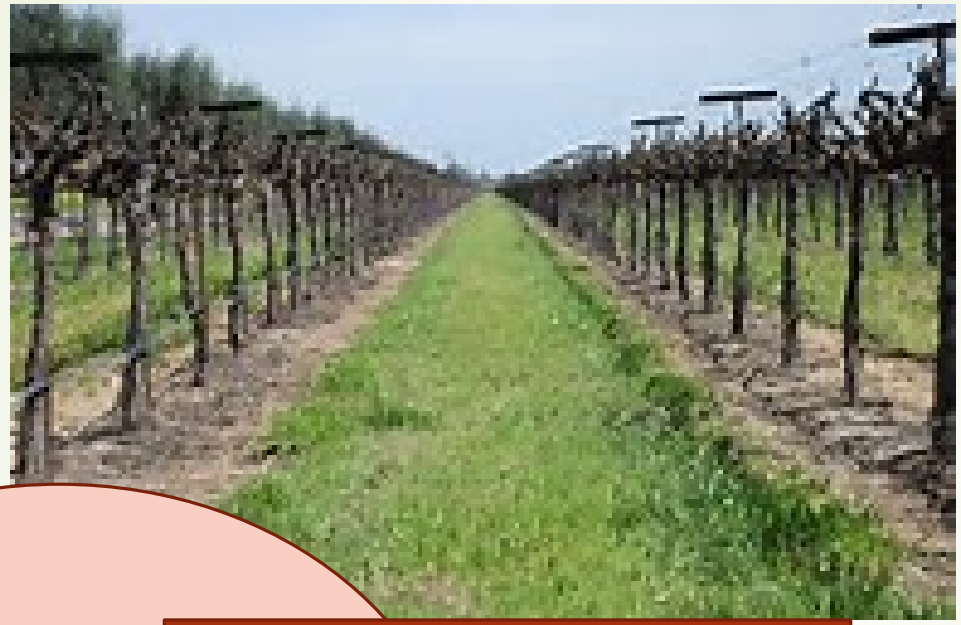
Runoff

Drainage

Water management

- How do we effectively manage the soil water availability in the root zone during the growing season?
- What is known and what is unknown?
- Known: precipitation regime
  - West coast- Mediterranean climate
  - Rest of US- temperate climate with summer rainfall
- Unknown
  - Rate of water use during the spring and summer months

Water dynamics



Rooting volume of the grape vine

Rooting volume of the cover crop

How do these areas interact during the early season?

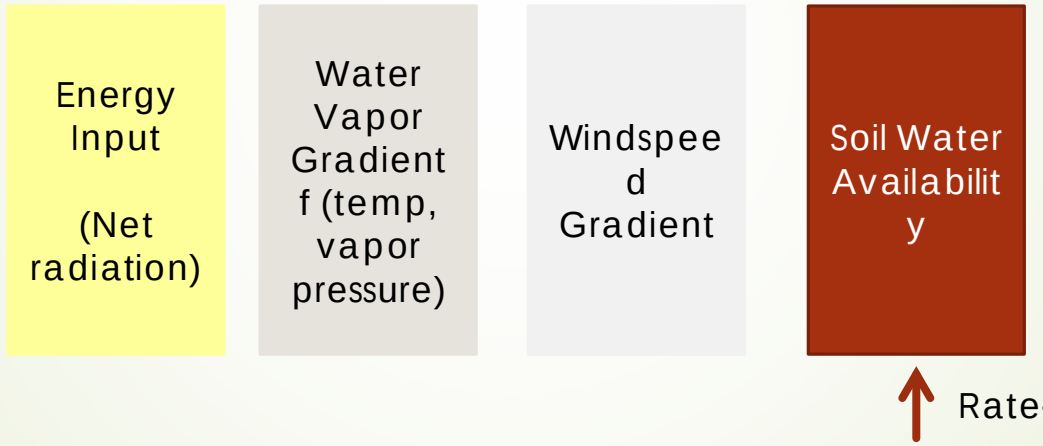
Water Management

- How do we manage soil water early in the growing season and how does that affect crop productivity?
- How do we manage soil water during the fruit development period to capture all of the genetic potential?
- How do we couple water and nutrient management to ensure productivity?

Evapotranspiration = Crop water use

ET = Soil water evaporation + Plant transpiration

Components of ET



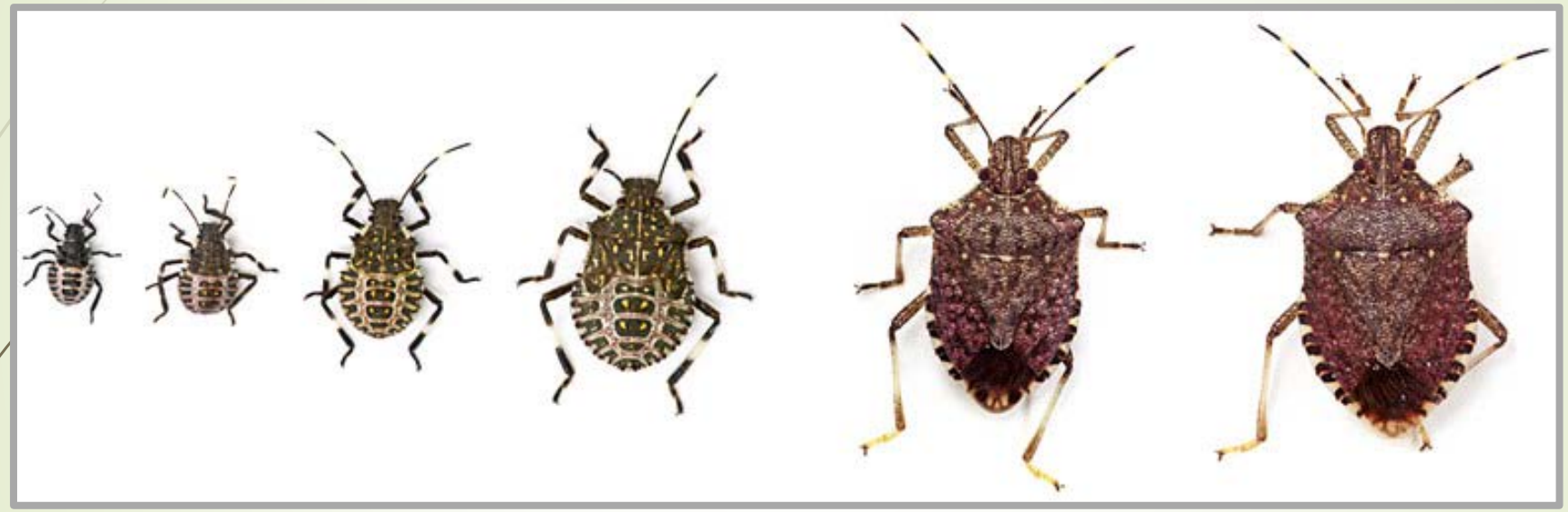
Potential ET (how much could evaporate) vs Actual ET (how much does)

Vineyard ET

ET models driven by soil water balance

ET models can utilize crop coefficients and leaf area index

Potential Geographical Range & Abundance of the Invasive Brown Marmorated Stink Bug under Climate Change Scenarios



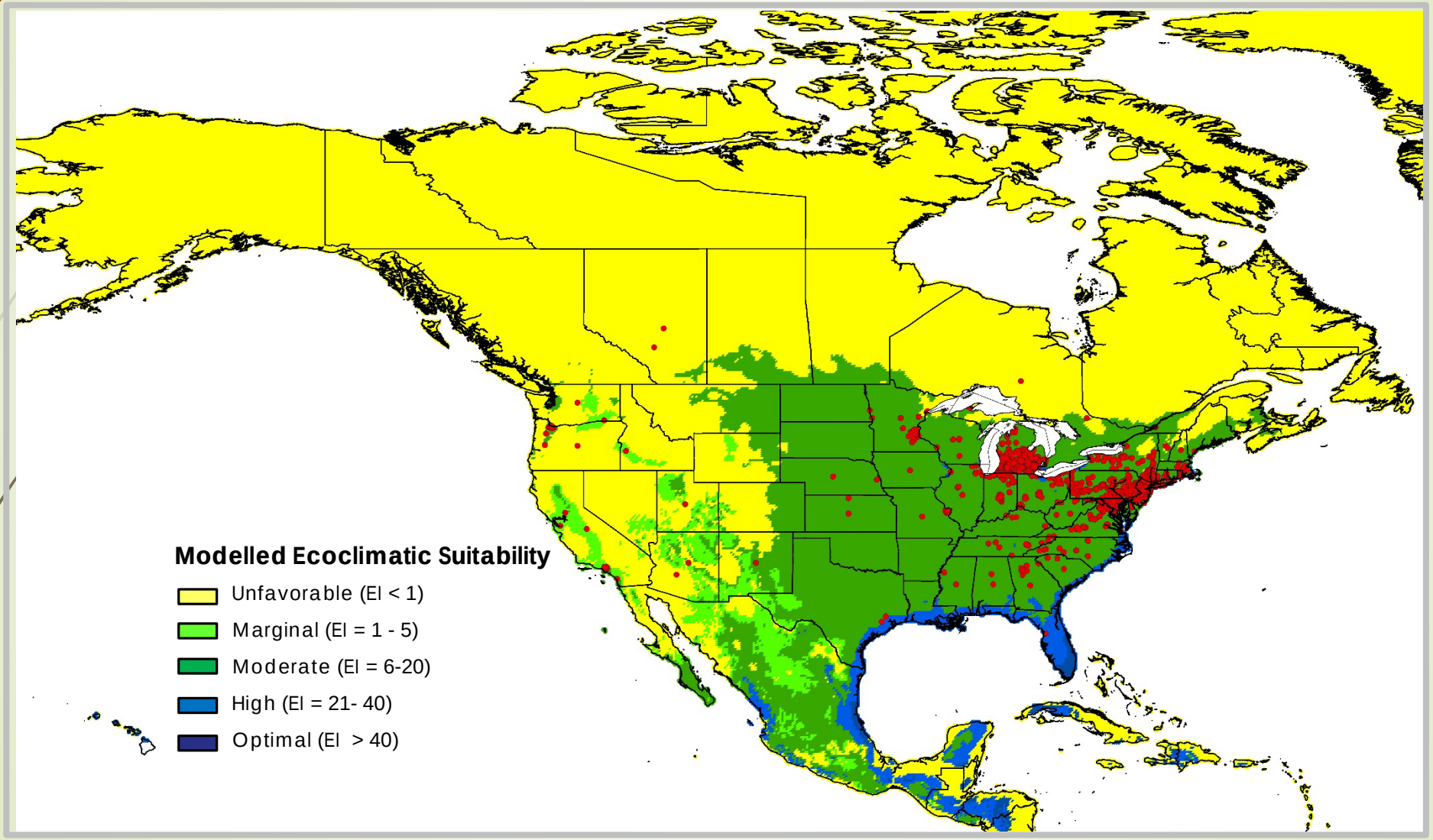
Erica J. Kistner

Midwest Climate Hub

ARS-USDA

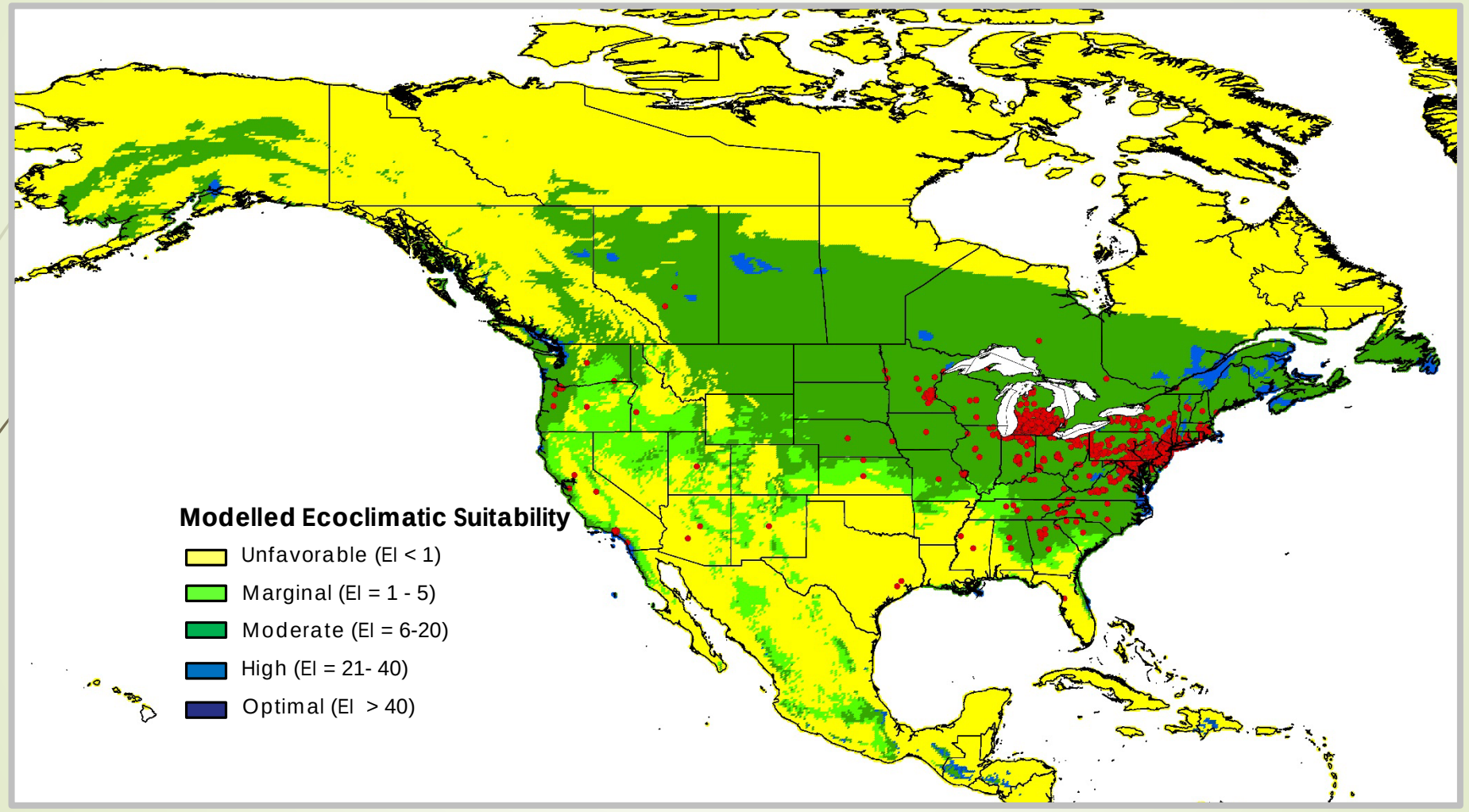
BMSB's North America Distribution

Present Time



- **Predicted distribution has 94% match with known distribution**
- **One generation per year reported in Mid-Atlantic and**

BMSB's North America Distribution
2100 SRES A2 Scenario



- **Southern latitudes no longer meet BMSB's winter diapause temperature requirements**
- **Two generations per year in Mid-Atlantic, Midwest, and Pacific Northwest**

Challenges

- Begin to quantify the dynamics of production relative to environmental conditions and the interaction with management
- Place the observed response (yield and quality) in the context of management changes and the environmental conditions
- Have to consider the complete lifecycle of the plant to determine how management decisions in one phenological stage affect responses in another stage.
- Have to place the system in an agroecological context to link pests, diseases, weeds into production context